Claims

[c1] 1.A cooling apparatus for fuel cell components comprising:
a base plate having a first end and a second end;
a first side plate coupled to said first end and a second side plate coupled to said second end;
a plurality of bottom ribs coupled to said base plate;
a plurality of upper ribs coupled to said bottom ribs; and
a top channel and a bottom channel formed between each of said plurality of upper ribs and each of said plurality of bottom ribs, respectively,
wherein said top channel and said bottom channel are disposed to allow a flow of a fluid therethrough and disposed to allow a portion of said fluid to alternate between said top channel and said bottom channel at a flow redirection area so as to enhance the heat transfer rate between said fluid and said fuel cell components.

[c2] 2.The cooling apparatus of claim 1, wherein said fuel cell components are selected from the group consisting of cathodes, anodes and electrolytes.

[c3] 3.The cooling apparatus of claim 1, wherein a plurality of concavities are disposed on a surface portion of said top channel and disposed on a surface portion of said bottom channel so as to cause hydrodynamic interactions and affect the heat transfer rate between said fluid and said concavities when said fluid is disposed over said concavities.

[c4] 4.The cooling apparatus of claim 3, wherein said concavities are selected from the group consisting of depressions, indentations, dimples and pits.

[c5] 5.The cooling apparatus of claim 1, wherein said fluid is selected from the group consisting of gaseous fuels and oxidants.

[c6] 6.The cooling apparatus of claim 1, wherein said upper ribs are disposed at an angle in the range between about 30 degrees and about 120 degrees with respect to said bottom ribs.

[c7] 7.A fuel cell assembly comprising:
at least one fuel cell having at least two electrodes and an electrolyte disposed

therebetween;

at least one cooling apparatus disposed over at least one of said electrodes, said cooling apparatus comprising:

a base plate having a first end and a second end;

a first side plate coupled to said first end and a second side plate coupled to said second end;

a plurality of bottom ribs coupled to said base plate;

a plurality of upper ribs coupled to said bottom ribs; and

a top channel and a bottom channel formed between each of said plurality of upper ribs and each of said plurality of bottom ribs, respectively,

wherein said top channel and said bottom channel are disposed to allow a flow of a fluid therethrough and disposed to allow a portion of said fluid to alternate between said top channel and said bottom channel at a flow redirection area so as to enhance the heat transfer rate between said fluid and said fuel cell.

[c8] 8.The fuel cell assembly of claim 7, wherein said fuel cell is selected from the group consisting of solid oxide fuel cells, proton exchange membrane or solid polymer fuel cells, molten carbonate fuel cells, phosphoric acid fuel cells, alkaline fuel cells, direct methanol fuel cells, regenerative fuel cells, and protonic ceramic fuel cells.

[c9] 9.The fuel cell assembly of claim 7, wherein said electrodes are selected from the group consisting of cathodes and anodes.

[c10] 10.The fuel cell assembly of claim 7, wherein a plurality of concavities are disposed on a surface portion of said top channel and disposed on a surface portion of said bottom channel so as to cause hydrodynamic interactions and affect the heat transfer rate between said fluid and said concavities when said fluid is disposed over said concavities.

[c11] 11.The fuel cell assembly of claim 10, wherein said concavities are selected from the group consisting of depressions, indentations, dimples and pits.

[c12] 12.The fuel cell assembly of claim 7, wherein a plurality of concavities are disposed on a surface portion of said electrodes so as to cause hydrodynamic

interactions and affect the heat transfer rate between said fluid and said fuel cell when said fluid is disposed over said concavities.

[c13] 13.The fuel cell assembly of claim 7, wherein said fluid is selected from the group consisting of gaseous fuels and oxidants.

[c14] 14.The fuel cell assembly of claim 7, wherein said upper ribs are disposed at an angle in the range between about 30 degrees and about 120 degrees with respect to said bottom ribs.